

Framboidal Pyrite: Prebiotic Catalyst & Molecular Scaffold?

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Russell (2004) created chemical gardens incorporating mackinawite and greigite. He contends that aggregates of greigite accumulated peptides, which protected adsorbed pyrophosphate and thus catalyzed the polymerization of organics. However, his model does not provide a satisfactory mechanism for cell membrane formation. Here, we present a new model for the role of iron sulfides in the origin of protocells utilizing framboidal pyrite.

Pyrite formation proceeds through mackinawite and greigite and probably coexists as some aggregates have more reactive surfaces. Pore size between framboidal pyrite microcrysts approximates the preferred μm range in modern cells (Weber *et al.* 2004). Pyrite catalyzes the hydrolysis of adsorbed ATP (Tessier *et al.*, 1998), adsorbs nucleic acids (Sowerby, Cohn Heckl & Holm, 2000) and degrades RNA in the absence of lipids (Cohn, Borda & Schoonen 2004). Greigite, surrounded by amphiphile-coated pyrite, may have served as catalytic surfaces for polymerization reactions.

Abiotically produced amphiphilic molecules spontaneously form bilayers resembling cell membranes (Deamer, 1985; Deamer & Pasley, 1989). Bilayers coating the pores of framboidal pyrite microcrysts could encapsulate nucleic acids in a vesicle (Hanczyc, Fujikawa & Szostak, 2003), protecting them from degradation by pyrite while allowing access to the catalytic surface of greigite. The bilayer could also protect pyrite against solubilization by amino acids (Tributsch *et al.*, 2002) and peptides could become inserted into these bilayers to create channels akin to those found in modern cells for the transport of materials across the membrane (Morris, 2002). Framboidal pyrite may have significantly facilitated the origin of protocellular structures.